PATENT ABSTRACTS OF JAPAN

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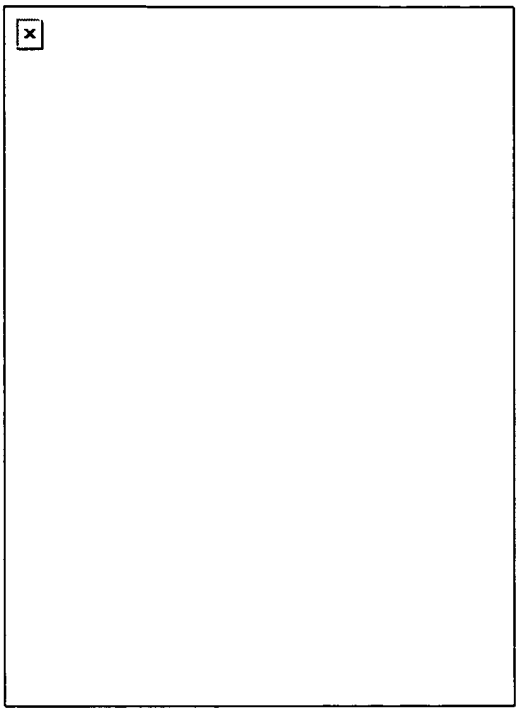
(54) PIEZOELECTRIC TYPE ELECTROACOUSTIC TRANSDUCER

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a piezoelectric type electroacoustic transducer in which adverse effect on vibrating plates is made less and the changes in the characteristics are reduced even though thermal deformation occurs and an external force is applied to the casings.

SOLUTION: The transducer is provided with piezoelectric vibrating plates 1 which have a quadrilateral shape bend and vibrate in a thickness direction by applying alternating signals between electrodes, casings 10 and 20 which store the plates 1 and a pair of terminals 11 and 12 which are inserted and formed into the casings. One tip parts of the terminals 11 and 12 being introduced into the internal sections of the casings are respectively provided with trunk sections 11c and 12c which are fixed to the inside surface center sections of the casings and both wing sections 11d and 12d which are extended toward corner sections from the trunk sections. The sections 11d and 12d are not fixed with respect to the casings and provided with stress releasing sections 11f and 12f that are formed between the sections 11c and 12c and the sections 11d and 12d so that the sections 11d and 12d are freely displaced in the internal side direction of the casings. The electrodes of the plates 1 are connected to at least one of the sections 11d and 12d by electrically conductive adhesive 14.



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CLAIMS

[Claim(s)]

[Claim 1] The piezo-electric diaphragm of the square which carries out crookedness vibration in the thickness direction by impressing an alternation signal to inter-electrode, The case which has the supporter which supports the supporter which supports two sides which the above-mentioned piezo-electric

diaphragm is contained and a piezo-electric diaphragm counters at least, or the corner of a piezo-electric diaphragm, In the piezo-electric mold electroacoustic transducer equipped with the terminal of the pair by which insert molding was carried out to the case so that the end section might be introduced into the medial surface of the case near [above-mentioned] the supporter and the other end might be exposed to the external surface of a case The end section of the above-mentioned terminal is equipped with the drum section fixed to the above-mentioned case, and the vane prolonged toward the corner section from this drum section. The stress relaxation section is formed so that the above-mentioned vane may not be fixed to a case and the displacement of a vane in the direction of the inside of a case may be attained between the drum section of a terminal, and a vane. The electrode of the above-mentioned piezo-electric diaphragm is a piezo-electric mold electroacoustic transducer characterized by electroconductive glue connecting with one [at least] vane of the above-mentioned terminal.

[Claim 2] The end face of the vane of the above-mentioned terminal is a piezo-electric mold electroacoustic transducer according to claim 1 characterized by inclining in the direction of a flare toward the direction of the inside of a case.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to piezo-electric mold electroacoustic transducers, such as a piezo-electric receiver and a piezo-electric sounder.

[0002]

[Description of the Prior Art] Conventionally, in electronic equipment, home electronics, a portable telephone, etc., the piezo-electric mold electroacoustic transducer is widely used as the piezo-electric sounder which generates an alarm tone and a sound of operation, or a piezo-electric receiver. Its thing of the structure which closed opening of a case with covering is common while this kind of piezo-electric mold electroacoustic transducer sticks a circular piezoelectric device on one side of a circular metal plate, constitutes a uni-morph mold diaphragm, and silicone rubber is used for it and it supports the periphery section of a metal plate in a circular case. However, when the circular diaphragm was used, there was a trouble that productive efficiency was bad and it was difficult for sound conversion efficiency to constitute low and small.

[0003] Then, the piezo-electric mold electroacoustic transducer of the surface mount mold which enabled improvement in productive efficiency, the improvement in sound conversion efficiency, and a miniaturization is proposed by using a square diaphragm (JP,2000-310990,A). The insulating case where this piezo-electric mold electroacoustic transducer had the supporter which supports a diaphragm a square piezo-electric diaphragm and inside the two side-attachment-wall sections which counter, and the terminal for external connection was prepared in the supporter, While two sides and supporter with which it has the cover plate which has a sound emission hole, a diaphragm is contained in a case, and a diaphragm counters are fixed with adhesives or an elastic sealing agent The closure of the clearance between remaining two sides and cases of a

diaphragm is carried out with an elastic sealing agent, a diaphragm and the 1st and 2nd current carrying part are electrically connected by electroconductive glue, and it has structure which the cover plate pasted up on the side-attachment-wall section opening edge of a case. Although the above-mentioned electroacoustic transducer uses the piezo-electric diaphragm of a uni-morph mold, what used the piezo-electric diaphragm which consists of electrostrictive ceramics of a laminated structure is known (JP,2001-95094,A).

[0004]

[Problem(s) to be Solved by the Invention] In the former, connection immobilization of the two sides of a diaphragm is carried out by electroconductive glue at the terminal fixed to the case. Therefore, a diaphragm has the problem of also influencing a diaphragm directly, when it is restrained strongly and a case carries out heat deformation in a case. For example, although a case carries out thermal expansion with heat when a case is mounted in a printed circuit board etc. by reflow soldering, the property of a diaphragm will change because of the coefficient-of-thermal-expansion difference of a case and a diaphragm. Moreover, also when stress is added from the exterior to a case, the direct force is transmitted also to a diaphragm, a property may change or the crack of a diaphragm may occur.

[0005] Then, even if heat deformation and external force join a case, the purpose of this invention lessens effect to a diaphragm, and is to offer a piezo-electric mold electroacoustic transducer with little property change.

[0006]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, invention concerning claim 1 The piezo-electric diaphragm of the square which carries out crookedness vibration in the thickness direction by impressing an alternation signal to inter-electrode, The case which has the supporter which supports the supporter which supports two sides which the above-mentioned piezo-electric diaphragm is contained and a piezo-electric diaphragm counters at least, or the corner of a piezo-electric diaphragm, In the piezo-electric mold

electroacoustic transducer equipped with the terminal of the pair by which insert molding was carried out to the case so that the end section might be introduced into the medial surface of the case near [above-mentioned] the supporter and the other end might be exposed to the external surface of a case The end section of the above-mentioned terminal is equipped with the drum section fixed to the above-mentioned case, and the vane prolonged toward the corner section from this drum section. The stress relaxation section is formed so that the above-mentioned vane may not be fixed to a case and the displacement of a vane in the direction of the inside of a case may be attained between the drum section of a terminal, and a vane. The piezo-electric mold electroacoustic transducer characterized by the electrode of the above-mentioned piezo-electric diaphragm being connected to one [at least] vane of the above-mentioned terminal by electroconductive glue is offered.

[0007] In this invention, a drum section and the vane prolonged toward both sides from this drum section are prepared in the end section of the insertion terminal introduced into the interior of a case, a drum section is fixed to a case, and the vane is made movable to the case. Moreover, the stress relaxation section is prepared between the drum section of a terminal, and a vane, and displacement of a vane is enabled in the direction of the inside of a case. One [at least] vane is connected with the electrode of a piezo-electric diaphragm by electroconductive glue. In order that the vane of a terminal may bend in the direction of the inside of a case and may prevent influencing of stress although the stress also tends to affect a piezo-electric diaphragm if a surrounding temperature change and external force are added, change does not arise in the electrical characteristics of a piezo-electric diaphragm, but the stable property is acquired.

[0008] Like claim 2, it is good to make the end face of the vane of a terminal incline in the direction of a flare toward the direction of the inside of a case. When insert molding of the terminal is carried out, resin will enclose the end face of a vane. The end face of a vane is caught in resin as the both-ends side of a vane is

a perpendicular field to a medial surface, and it may be unable to displace inside. Then, he is trying not to become the hindrance at the time of a vane displacing inside by making a both-ends side into an inclined plane.

[0009]

[Embodiment of the Invention] Drawing 1 - drawing 4 show the piezo-electric mold electroacoustic transducer of the surface mount mold which is the 1st operation gestalt of this invention. The electroacoustic transducer of this operation gestalt fitted the application corresponding to the frequency of a large range like a piezo-electric earphone, and is equipped with the piezo-electric diaphragm 1, the case 10, and cover plate 20 of a laminated structure. Here, a case consists of a case 10 and a cover plate 20.

[0010] As shown in drawing 5 and drawing 6 , as for a diaphragm 1, the laminating of the two-layer electrostrictive ceramics layers 1a and 1b is carried out, the principal plane electrodes 2 and 3 are formed in the front flesh-side principal plane of a diaphragm 1, and the internal electrode 4 is formed among the ceramic layers 1a and 1b. As a thick wire arrow head shows, in the thickness direction, polarization of the two ceramic layers 1a and 1b is carried out in the same direction. The principal plane electrode 2 on a side front and the principal plane electrode 3 on a background are formed a little shorter than the side length of a diaphragm 1, and the end is connected to the end-face electrode 5 formed in one end face of a diaphragm 1. Therefore, the principal plane electrodes 2 and 3 of a front flesh side are connected mutually. The internal electrode 4 was mostly formed in the symmetry configuration with the principal plane electrodes 2 and 3, it is separated from the end of an internal electrode 4 of the internal electrode with the above-mentioned end-face electrode 5, and the other end is connected to the end-face electrode 6 formed in the other end side of a diaphragm 1. In addition, the end-face electrode 6 and the flowing auxiliary electrode 7 are formed in the front rear face of the other end of a diaphragm 1.

[0011] The wrap resin layers 8 and 9 are formed in the front rear face of a diaphragm 1 in the principal plane electrodes 2 and 3. These resin layers 8 and 9

are formed in order to prevent the crack of the diaphragm 1 by the fall impact. The notches 8a and 9a which the principal plane electrodes 2 and 3 expose near the corner of the vertical angle of a diaphragm 1, and the notches 8b and 9b which an auxiliary electrode 7 exposes are formed in the resin layers 8 and 9 of a front flesh side. In addition, although Notches 8a, 8b, 9a, and 9b may be formed only in front flesh-side one side, in order to abolish the directivity of a front flesh side, in this example, it has prepared in the front rear face. Moreover, it is not necessary to use an auxiliary electrode 7 as the band electrode of constant width, and only the part corresponding to Notches 8b and 9b may be established. Here, the 10mmx10mmx40micrometer PZT system ceramics was used as ceramic layers 1a and 1b, and the polyamidoimide system resin whose thickness is 3-10 micrometers as resin layers 8 and 9 was used.

[0012] The case 10 is formed in the core box of the square which has bottom wall section 10a and the four side-attachment-wall sections 10b-10e with a resin ingredient. As a resin ingredient, heat-resistant resin, such as LCP (liquid crystal polymer), SPS (syndiotactic polystyrene), PPS (polyphenylene sulfide), and epoxy, is desirable. 10f of annular level difference sections is prepared in the inner circumference of the four side-attachment-wall sections 10b-10e, and the inside sections 11a and 12a of the terminals 11 and 12 of a pair are introduced on 10f of level difference sections of the inside which are the two side-attachment-wall sections 10b and 10d which counter. Insert molding of the terminals 11 and 12 is carried out to a case 10, and the lateral parts 11b and 12b exposed to the exterior of a case 10 are bent to the base side of a case 10 along the external surface which is the side-attachment-wall sections 10b and 10d.

[0013] As shown in drawing 7 - drawing 9 , the inside sections 11a and 12a of terminals 11 and 12 have lateral parts 11b and 12b, the drum sections 11c and 12c of the same width of face, and the both-wings sections 11d and 12d prolonged from drum sections 11c and 12c to both sides, and the both-wings sections 11d and 12d are prolonged to near the corner section of a case 10. Drum sections 11c and 12c may form the holes 11e and 12e where drum

sections 11c and 12c are filled up with resin for immobilization, although fixed in the side-attachment-wall sections 10b and 10d of a case 10. The both-wings sections [11d and 12d] medial surface is exposed to the inside of a case 10 as shown in drawing 8 , and between drum sections 11c and 12c and the both-wings sections 11d and 12d, the narrow stress relaxation sections 11f and 12f are formed. Therefore, the both-wings sections 11d and 12d have structure which can move to a way among cases 10 as an arrow head shows to drawing 7 . The both-wings sections [11d and 12d] end faces 11g and 12g incline in the direction of a flare toward the inside of a case 10, and it is made not to be the hindrance of the motion whose cases 10 which consist of resin are the both-wings sections 11d and 12d.

[0014] As shown in drawing 1 , 10g of supporters for supporting two sides which a diaphragm 1 counters is formed in the inside which is 10f of level difference sections which terminals 11 and 12 exposed lower one step than 10f of level difference sections. Therefore, if a diaphragm 1 is laid on 10g of supporters, the top panel of a diaphragm 1 and the top face of the inside sections 11a and 12a of terminals 11 and 12 will become the same height mostly. In addition, 10h of 1st sound emission hole is formed in bottom wall section 10a.

[0015] At the time of the insert molding of terminals 11 and 12, as shown in drawing 10 (a), lateral parts 11b and 12b are horizontally prolonged to the method of both sides of a case 10. Then, a tip side is bent below like drawing 10 (b) from the pars intermedia of the lateral parts 11b and 12b of terminals 11 and 12. At this time, it is good to make a bending include angle a little larger than 90 degrees. And it bends below like drawing 10 (c) in the root part of the lateral parts 11b and 12b of terminals 11 and 12, and the medial surface of terminals 11 and 12 is made to meet the side face of a case 10. Although fitting of the bent part is carried out to slot 10i formed in the base of a case 10 in this condition, it can prevent that lateral part 11b of terminals 11 and 12 and 12b tip lose touch with the base of a case 10 by bending at 90 degrees or more by (b) of drawing 10 .

[0016] A diaphragm 1 is contained by the case 10 and fixed to the both-wings sections 11d and 12d of terminals 11 and 12 by the elastic support agent 13 by four places. That is, the elastic support agent 13 is applied between 11d of one vanes of the principal plane electrode 2 exposed to notch 8a in a diagonal location, and a terminal 11, and between 12d of one vanes of the auxiliary electrode 7 exposed to notch 8b, and a terminal 12. Moreover, the elastic support agent 13 is applied about two in the remaining diagonal location. In addition, although the elastic support agent 13 was applied to the oblong ellipse form here, a spreading configuration is not restricted to an ellipse form. As an elastic support agent 13, the urethane system adhesives of 3.7x106 Pa are used, for example for the Young's modulus after hardening. Moreover, since the viscosity in the condition of this elastic support agent 13 of not hardening has the property which cannot permeate easily highly (for example, 50 - 120 dPa-s), when it applies the elastic support agent 13, there is no possibility that the elastic support agent 13 may flow and fall to 10g of supporters through the clearance between a diaphragm 1 and a case 10. Heat hardening is carried out after applying the elastic support agent 13. In addition, as the fixed approach of a diaphragm 1, after containing a diaphragm 1 in a case 10, the elastic support agent 13 may be applied by a dispenser etc., but where the elastic support agent 13 is beforehand applied to a diaphragm 1, a diaphragm 1 may be held in a case 10.

[0017] After stiffening the elastic support agent 13, it applies to an ellipse form so that the elastic support agent 13 top to which electroconductive glue 14 was applied by the ellipse form may be crossed, and 12d of vanes of the principal plane electrode 2, 11d of vanes of a terminal 11 and an auxiliary electrode 7, and a terminal 12 is connected, respectively. As electroconductive glue 14, the urethane system conductive paste of 0.3x109 Pa is used, for example for the Young's modulus after hardening. After applying electroconductive glue 14, heat hardening of this is carried out. The spreading configuration of electroconductive glue 14 is not restricted to an ellipse form, and just connects the principal plane electrode 2, 11d of vanes and an auxiliary electrode 7, and 12d of vanes ranging

over the elastic support agent 13.

[0018] After applying and stiffening electroconductive glue 14, the elastic encapsulant 15 is applied to the clearance between the perimeter perimeter of a diaphragm 1, and the inner circumference section of a case 10, and the air leak between the side front of a diaphragm 1 and a background is prevented. Heat hardening is carried out after applying the elastic encapsulant 15 annularly. As elastic encapsulant 15, the silicone system adhesives of 3.0x105 Pa are used, for example for the Young's modulus after hardening. In addition, as shown in drawing 4 , it is the inside of the two side-attachment-wall sections 10c and 10e, and the elastic encapsulant 15 may flow in a location lower than 10g of supporters, and slot 10j for stops may be formed in it. In this case, it can prevent that the elastic encapsulant 15 flows and falls to bottom wall section 10a by slot 10j.

[0019] After fixing a diaphragm 1 to a case 10 as mentioned above, a cover plate 20 pastes top-face opening of a case 10 with adhesives 21. A cover plate 20 is formed with the same ingredient as a case 10. By pasting up a cover plate 20, sound space is formed between a cover plate 20 and a diaphragm 1. The 2nd sound emission hole 22 is formed in the cover plate 20. The piezo-electric mold electroacoustic transducer of a surface mount mold is completed as mentioned above.

[0020] At the electroacoustic transducer of this operation gestalt, crookedness vibration of the diaphragm 1 can be carried out in area crookedness mode by impressing a predetermined alternation electrical potential difference between a terminal 11 and 12. Since the electrostrictive ceramics layer the direction of polarization and whose direction of electric field are the same directions is shrunken in the direction of a flat surface and the electrostrictive ceramics layer the direction of polarization and whose direction of electric field are hard flow is extended in the direction of a flat surface, it is crooked in the thickness direction as a whole. With this operation gestalt, a diaphragm 1 is the laminating structure of the ceramics, and since two oscillating fields (ceramic layer) arranged in order

in the thickness direction vibrate to hard flow mutually, compared with a uni-morph mold diaphragm, the big amount of displacement, i.e., big sound pressure, can be obtained.

[0021] In case the surface mount of the electroacoustic transducer concerning this operation gestalt is carried out to a printed circuit board etc., a case 10 carries out thermal expansion with heat, such as reflow solder. Since the coefficient of thermal expansion is small compared with the case 10 of the product [diaphragm / 1 / which consists of ceramics] made of resin, tensile stress acts on a diaphragm 1. For this tensile force, the property of a diaphragm 1 may change or a crack may occur. However, as shown in drawing 9 , since it can displace to the inside of a case 10, the both-wings sections 11d and 12d of the terminals 11 and 12 by which insert molding was carried out to the case 10 can mitigate the tensile stress concerning a diaphragm 1. Therefore, the property of a diaphragm 1 can change or it can prevent that a crack occurs.

[0022] Drawing 11 shows other examples of the terminal concerning this invention. With this operation gestalt, the crank configuration sections 11h and 12h which are the stress relaxation sections are formed between the drum sections 11c and 12c of terminals 11 and 12, and the both-wings sections 11d and 12d. In this case, compared with the narrow sections 11f and 12f like the 1st operation gestalt, a both-wings sections [11d and 12d] variation rate becomes still easier.

[0023] Drawing 12 shows the 2nd operation gestalt of the electroacoustic transducer concerning this invention. While forming the crank configuration sections 11h and 12h which are the stress relaxation sections with this operation gestalt between the drum sections 11c and 12c of terminals 11 and 12, and the both-wings sections 11d and 12d The both-wings sections 11d and 12d of terminals 11 and 12 are fixed to migration impossible at a case 10, and drum sections 11c and 12c are made movable in the direction of inside and outside to the side-attachment-wall sections 10b and 10d of a case 10. In addition, the resin restoration holes 11e and 12e are not established in drum sections 11c and 12c

in this case.

[0024] In this case, the stress which joined the lateral parts 11b and 12b of the terminals 11 and 12 which are the soldering sections from the printed circuit board which carried out the surface mount is eased when drum sections 11c and 12c move in the direction of inside and outside. Moreover, the variation rate of drum sections 11c and 12c is absorbable with the stress relaxation sections 11h and 12h prepared between drum sections 11c and 12c and the both-wings sections 11d and 12d. In addition, although the structure of a publication was adopted as drawing 11 as the stress relaxation sections 11h and 12h, you may be the narrow section like drawing 7 .

[0025] This invention is not limited to the above-mentioned operation gestalt, and can be changed in the range which does not deviate from the meaning of this invention. Although the piezo-electric diaphragm of the above-mentioned operation gestalt carries out the laminating of the two-layer electrostrictive ceramics layer, what carried out the laminating of the three or more-layer electrostrictive ceramics layer may be used. Moreover, the uni-morph mold or bimorph mold diaphragm which stuck the piezo-electric plate on one side or both sides of not only the layered product of an electrostrictive ceramics layer but a metal plate may be used as a piezo-electric diaphragm. Moreover, Vanes 11d and 12d may be formed in the one side through which it flows not only in what forms Vanes 11d and 12d in the both sides of the drum sections 11C and 12C of terminals 11 and 12 but in a diaphragm. It may change to 10g of the supporter of two sides of a case 10, and a supporter may be formed in 4 square corner sections of the case inside further again. The case of this invention contains a piezo-electric diaphragm, and does not restrict it to what consisted of a case of a concave cross-section configuration like an operation gestalt, and a cover plate adhered to the top face that what is necessary is just what carries out insert molding of the terminal.

[0026]

[Effect of the Invention] While a drum section and the vane prolonged toward the

side from this drum section are prepared in the end section of the insertion terminal which was introduced into the interior of a case according to invention according to claim 1 by the above explanation so that clearly, and fixing a drum section to a case, a vane is made movable to a case. And since the stress relaxation section was prepared between the drum section of a terminal, and the vane and the vane made displacement possible in the direction of the inside of a case, even when stress acts on a piezo-electric diaphragm by a surrounding temperature change etc., the vane of a terminal bends and absorbs the stress in the direction of the inside of a case. Therefore, as well as the crack of a piezo-electric diaphragm, change of electrical characteristics is not produced, either but the stable property is acquired.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the decomposition perspective view of the 1st operation gestalt of the piezo-electric mold electroacoustic transducer concerning this invention.

[Drawing 2] It is a top view in the condition of having excepted the cover plate and elastic encapsulant of a piezo-electric mold electroacoustic transducer which

are shown in drawing 1 .

[Drawing 3] It is the A-A line stairway sectional view of drawing 2 .

[Drawing 4] It is the B-B line sectional view of drawing 2 .

[Drawing 5] It is the perspective view of the piezo-electric diaphragm used for the piezo-electric mold electroacoustic transducer of drawing 1 .

[Drawing 6] It is a stairway sectional view by the C-C line of drawing 5 .

[Drawing 7] It is the perspective view of a terminal.

[Drawing 8] It is the perspective view showing signs that one terminal displaces to a case.

[Drawing 9] It is the top view showing signs that one terminal displaces to a case.

[Drawing 10] It is process drawing showing the process which bends the terminal which carried out insert molding in a case.

[Drawing 11] It is the top view of other examples of a terminal.

[Drawing 12] It is a top view in the condition of having excepted the cover plate and elastic encapsulant of the 2nd operation gestalt of a piezo-electric mold electroacoustic transducer concerning this invention.

[Description of Notations]

1 Piezo-electric Diaphragm

10 Case

10g Supporter

11 12 Terminal

11a, 12a Inside section (end section)

11b, 12b Lateral part (other end)

11c, 12c Drum section

11d, 12d Vane

14 Electroconductive Glue

15 Elastic Encapsulant

20 Cover Plate

[Translation done.]

* NOTICES *

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damages caused by the use of this translation.

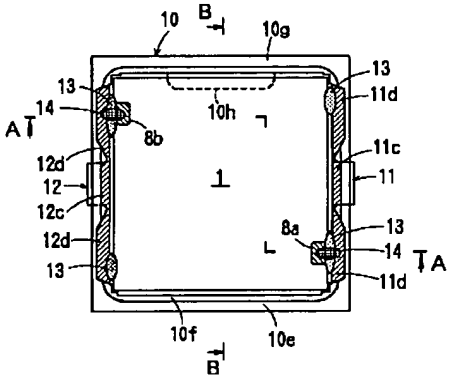
1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.**** shows the word which can not be translated.

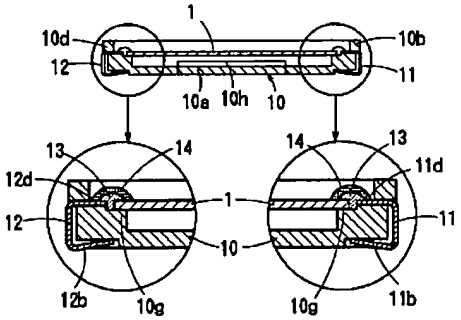
3.In the drawings, any words are not translated.

DRAWINGS

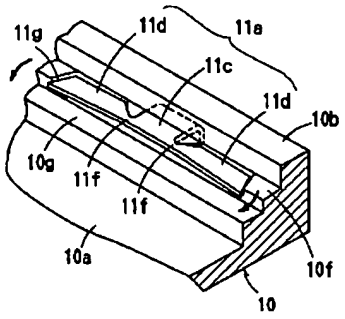
[Drawing 2]



[Drawing 3]



[Drawing 8]



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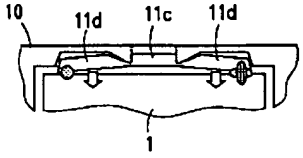

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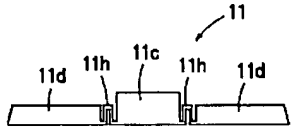

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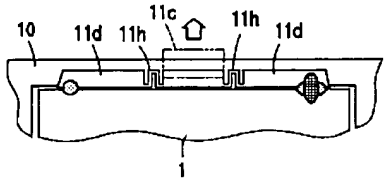
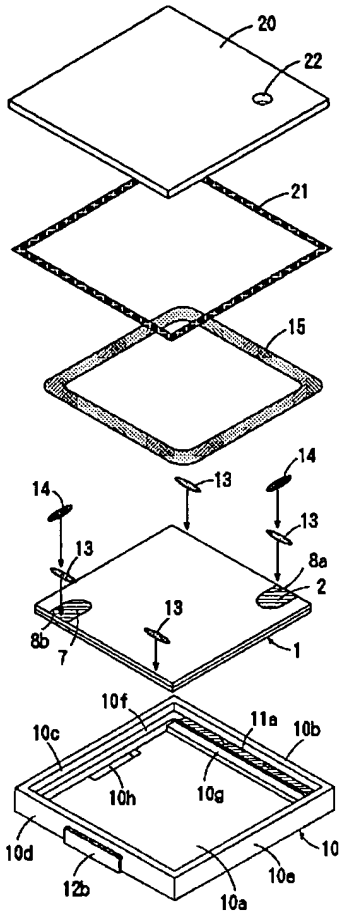
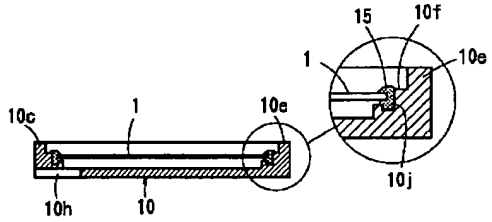


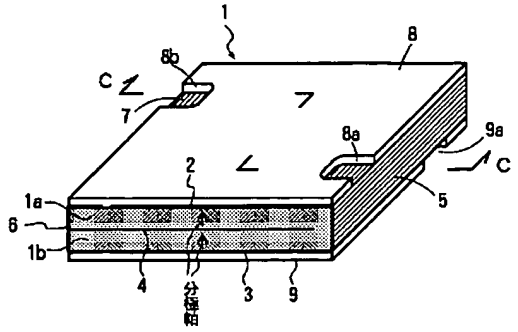
[Drawing 1]



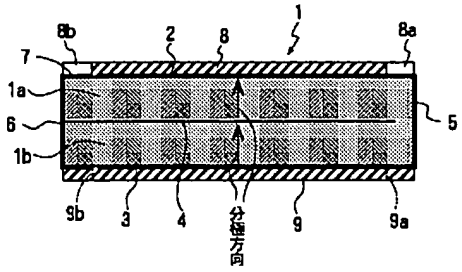
[Drawing 4]



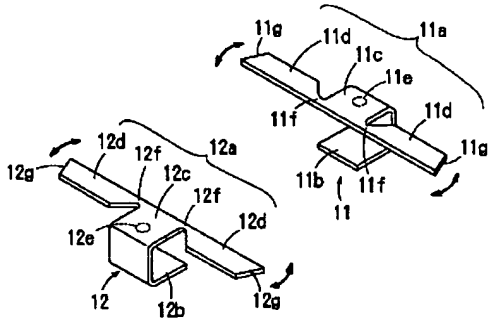
[Drawing 5]



[Drawing 6]



[Drawing 7]



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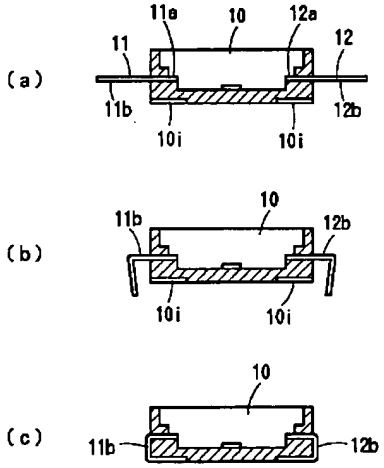

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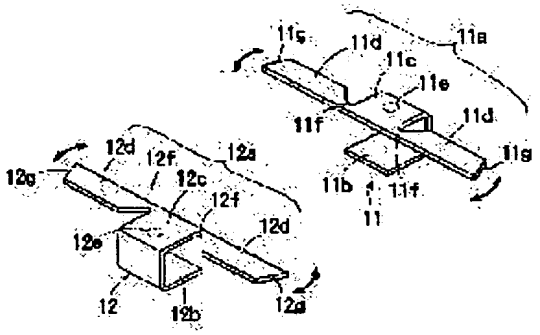
KOSUGI YUJI
SUMIDA MANABU

(54) PIEZOELECTRIC TYPE ELECTROACOUSTIC TRANSDUCER

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a piezoelectric type electroacoustic transducer in which adverse effect on vibrating plates is made less and the changes in the characteristics are reduced even though thermal deformation occurs and an external force is applied to the casings.
SOLUTION: The transducer is provided with piezoelectric vibrating plates 1 which have a quadrilateral shape bend and vibrate in a thickness direction by applying alternating signals between electrodes, casings 10 and 20 which store the plates 1 and a pair of terminals 11 and 12 which are inserted and formed into the casings. One tip parts of the terminals 11 and 12 being introduced into the internal sections of the casings are respectively provided with trunk sections 11c and 12c which are fixed to the inside surface center sections of the casings and both wing sections 11d and 12d which are extended toward corner sections from the trunk sections. The sections 11d and 12d are not fixed with respect to the casings and provided with stress releasing sections 11f and 12f that are formed between the sections 11c and 12c and the sections 11d and 12d so that the sections 11d and 12d are freely displaced in the internal side direction of the casings. The electrodes of the plates 1 are connected to at least one of the sections 11d and 12d by electrically conductive adhesive 14.



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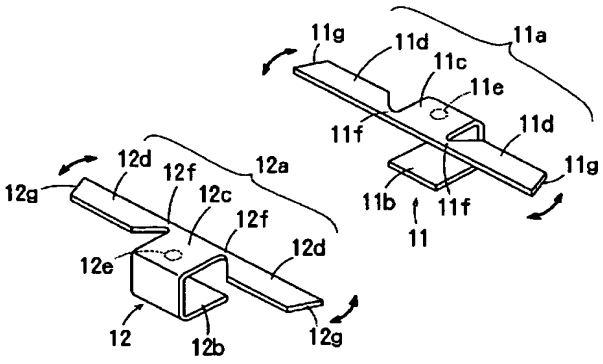
最終頁に続く

(54)【発明の名称】圧電型電気音響変換器

(57)【要約】
【課題】筐体に熱変形や外力が加わっても、振動板に対する影響を少なくし、特性変化の少ない圧電型電気音響変換器を提供するを提供する。
【解決手段】電極間に交番信号を印加することにより厚み方向に屈曲振動する四角形の圧電振動板１と、圧電振動板１を収納する筐体１０，２０と、筐体にインサート成形された一対の端子１１，１２とを備えた圧電型電気音響変換器において、端子１１，１２の筐体の内部に導入された一端部は、筐体の内側面中央部に固定された胴部１１ｃ，１２ｃと、この胴部からコーナ部に向かって延びる両翼部１１ｄ，１２ｄとを備えており、両翼部１１ｄ，１２ｄは筐体に対して固定されておらず、かつ胴部と両翼部との間に両翼部が筐体の内側方向に変位可能となるよう応力緩和部１１ｆ，１２ｆが形成されている。圧電振動板の電極は端子１１，１２の少なくとも一方の翼部１１ｄ，１２ｄに導電性接着剤１４により接続されている。



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【特許請求の範囲】

【請求項１】電極間に交番信号を印加することにより厚み方向に屈曲振動する四角形の圧電振動板と、上記圧電振動板を収納し、圧電振動板の少なくとも対向する２辺を支持する支持部または圧電振動板の角部を支持する支持部を有する筐体と、上記支持部近傍の筐体の内側面に一端部が導入され、他端部が筐体の外面に露出するよう筐体にインサート成形された一対の端子とを備えた圧電型電気音響変換器において、上記端子の一端部は、上記筐体に固定された胴部と、この胴部からコーナ部に向かって延びる翼部とを備えており、上記翼部は筐体に対して固定されておらず、かつ端子の胴部と翼部との間に翼部が筐体の内側方向に変位可能となるよう応力緩和部が形成されており、上記圧電振動板の電極は上記端子の少なくとも一方の翼部に導電性接着剤により接続されていることを特徴とする圧電型電気音響変換器。

【請求項２】上記端子の翼部の端面は、筐体の内側方向に向かって拡がり方向に傾斜していることを特徴とする請求項１に記載の圧電型電気音響変換器。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は圧電レシーバや圧電サウンダなどの圧電型電気音響変換器に関するものである。

【０００２】

【従来の技術】従来、電子機器、家電製品、携帯電話機などにおいて、警報音や動作音を発生する圧電サウンダあるいは圧電レシーバとして圧電型電気音響変換器が広く用いられている。この種の圧電型電気音響変換器は、円形の金属板の片面に円形の圧電素子を貼り付けてユニモルフ型振動板を構成し、金属板の周縁部を円形のケースの中にシリコーンゴムを用いて支持するとともに、ケースの開口部をカバーで閉鎖した構造のものが一般的である。しかしながら、円形の振動板を用いると、生産効率が悪く、音響変換効率が低く、しかも小型に構成することが難しいという問題点があった。

【０００３】そこで、四角形の振動板を用いることで、生産効率の向上、音響変換効率の向上および小型化を可能とした表面実装型の圧電型電気音響変換器が提案されている（特開２０００－３１０９９０号）。この圧電型電気音響変換器は、四角形の圧電振動板と、対向する２つの側壁部の内側に振動板を支持する支持部を持ち、支持部に外部接続用の端子が設けられた絶縁性ケースと、放音孔を有する蓋板とを備え、ケース内に振動板が収納され、振動板の対向する２辺と支持部とが接着剤または弾性封止材で固定されるとともに、振動板の残りの２辺とケースとの隙間が弾性封止材で封止され、振動板と第１，第２の導電部とが導電性接着剤により電気的に接続され、ケースの側壁部開口端に蓋板が接着された構造となっている。上記電気音響変換器はユニモルフ型の圧電振動板を使用したものであるが、積層構造の圧電セラミックスよりなる圧電振動板を使用したものも知られている（特開２００１－９５０９４号）。

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【０００４】

【発明が解決しようとする課題】従来では、振動板の２辺がケースに固定された端子に導電性接着剤により接続固定されている。そのため、振動板はケースによって強く拘束され、ケースが熱変形したりすると、振動板にも直接影響するという問題がある。例えば、ケースをプリント基板などにリフロー半田付けにより実装した際、熱によってケースが熱膨張するが、ケースと振動板との熱膨張係数差のため、振動板の特性が変化してしまう。また、ケースに対して外部から応力が加わった時も、振動板にも直接力が伝達され、特性が変化したり、振動板の割れが発生することがある。

【０００５】そこで、本発明の目的は、筐体に熱変形や外力が加わっても、振動板に対する影響を少なくし、特性変化の少ない圧電型電気音響変換器を提供することにある。

【０００６】

【課題を解決するための手段】上記目的を達成するため、請求項１に係る発明は、電極間に交番信号を印加することにより厚み方向に屈曲振動する四角形の圧電振動板と、上記圧電振動板を収納し、圧電振動板の少なくとも対向する２辺を支持する支持部または圧電振動板の角部を支持する支持部を有する筐体と、上記支持部近傍の筐体の内側面に一端部が導入され、他端部が筐体の外面に露出するよう筐体にインサート成形された一対の端子とを備えた圧電型電気音響変換器において、上記端子の一端部は、上記筐体に固定された胴部と、この胴部からコーナ部に向かって延びる翼部とを備えており、上記翼部は筐体に対して固定されておらず、かつ端子の胴部と翼部との間に翼部が筐体の内側方向に変位可能となるよう応力緩和部が形成されており、上記圧電振動板の電極は上記端子の少なくとも一方の翼部に導電性接着剤により接続されていることを特徴とする圧電型電気音響変換器を提供する。

【０００７】本発明では、筐体の内部に導入されたインサート端子の一端部に、胴部とこの胴部から両側に向かって延びる翼部とを設け、胴部を筐体に固定し、翼部を筐体に対して移動可能としてある。また、端子の胴部と翼部との間に応力緩和部を設け、翼部が筐体の内側方向に変位可能としてある。少なくとも一方の翼部は導電性接着剤により圧電振動板の電極と接続される。周囲の温度変化や外力が加わると、その応力が圧電振動板にも波及しようとするが、端子の翼部が筐体の内側方向に撓んで応力の波及を防止するため、圧電振動板の電気的特性に変化が生じず、安定した特性が得られる。

【０００８】請求項２のように、端子の翼部の端面を、筐体の内側方向に向かって拡がり方向に傾斜させるのが

よい。端子をインサート成形すると、翼部の端面を樹脂が取り囲むことになる。翼部の両端面が内側面に対して垂直な面であると、翼部の端面が樹脂に引っ掛かって内側に変位できない可能性がある。そこで、両端面を傾斜面とすることで、翼部が内側に変位する際の妨げにならないようにしている。

【０００９】

【発明の実施の形態】図１～図４は本発明の第１の実施形態である表面実装型の圧電型電気音響変換器を示す。この実施形態の電気音響変換器は、圧電受話器のように広いレンジの周波数に対応する用途に適したものであり、積層構造の圧電振動板１とケース１０と蓋板２０とを備えている。ここでは、ケース１０と蓋板２０とで筐体が構成される。

【００１０】振動板１は、図５，図６に示すように、２層の圧電セラミックス層１ａ，１ｂを積層したものであり、振動板１の表裏主面には主面電極２，３が形成され、セラミックス層１ａ，１ｂの間には内部電極４が形成されている。２つのセラミックス層１ａ，１ｂは、太線矢印で示すように厚み方向において同一方向に分極されている。表側の主面電極２と裏側の主面電極３は、振動板１の辺長よりやや短く形成され、その一端は振動板１の一方の端面に形成された端面電極５に接続されている。そのため、表裏の主面電極２，３は相互に接続されている。内部電極４は主面電極２，３とほぼ対称形状に形成され、内部電極４の一端は上記端面電極５と離れており、他端は振動板１の他端面に形成された端面電極６に接続されている。なお、振動板１の他端部の表裏面には、端面電極６と導通する補助電極７が形成されている。

【００１１】振動板１の表裏面には、主面電極２，３を覆う樹脂層８，９が形成されている。この樹脂層８，９は、落下衝撃による振動板１の割れを防止する目的で設けられている。表裏の樹脂層８，９には、振動板１の対角の角部近傍に、主面電極２，３が露出する切欠部８ａ，９ａと、補助電極７が露出する切欠部８ｂ，９ｂとが形成されている。なお、切欠部８ａ，８ｂ，９ａ，９ｂは表裏一方にのみ設けてもよいが、表裏の方向性をなくすため、この例では表裏面に設けてある。また、補助電極７は、一定幅の帯状電極とする必要はなく、切欠部８ｂ，９ｂに対応する箇所のみ設けてもよい。ここでは、セラミックス層１ａ，１ｂとして１０ｍｍ×１０ｍｍ×４０μｍのＰＺＴ系セラミックスを使用し、樹脂層８，９として厚みが３～１０μｍのポリアミドイミド系樹脂を使用した。

【００１２】ケース１０は樹脂材料で底壁部１０ａと４つの側壁部１０ｂ～１０ｅとを持つ四角形の箱型に形成されている。樹脂材料としては、ＬＣＰ（液晶ポリマー），ＳＰＳ（シンジオタクチックポリスチレン），ＰＰＳ（ポリフェニレンサルファイド），エポキシなどの耐熱樹脂が望ましい。４つの側壁部１０ｂ～１０ｅの内周には環状の段差部１０ｆが設けられ、対向する２つの側壁部１０ｂ，１０ｄの内側の段差部１０ｆ上に、一対の端子１１，１２の内側部１１ａ，１２ａが導入されている。端子１１，１２はケース１０にインサート成形されたものであり、ケース１０の外部に露出した外側部１１ｂ，１２ｂが側壁部１０ｂ，１０ｄの外面に沿ってケース１０の底面側へ折り曲げられている。

【００１３】図７～図９に示すように、端子１１，１２の内側部１１ａ，１２ａは、外側部１１ｂ，１２ｂと同一幅の胴部１１ｃ，１２ｃと、胴部１１ｃ，１２ｃから両側へ延びる両翼部１１ｄ，１２ｄとを有しており、両翼部１１ｄ，１２ｄはケース１０のコーナ部近傍まで延びている。胴部１１ｃ，１２ｃはケース１０の側壁部１０ｂ，１０ｄの中に固定されているが、固定のために胴部１１ｃ，１２ｃに樹脂が充填される穴１１ｅ，１２ｅを形成してもよい。両翼部１１ｄ，１２ｄの内側面は、図８に示すようにケース１０の内側へ露出しており、胴部１１ｃ，１２ｃと両翼部１１ｄ，１２ｄとの間には幅狭な応力緩和部１１ｆ，１２ｆが形成されている。そのため、両翼部１１ｄ，１２ｄは、図７に矢印で示すようにケース１０の内方へ動き得る構造となっている。両翼部１１ｄ，１２ｄの端面１１ｇ，１２ｇは、ケース１０の内側に向かって拡がり方向に傾斜しており、樹脂よりなるケース１０が両翼部１１ｄ，１２ｄの動きの妨げにならないようにしてある。

【００１４】端子１１，１２が露出した段差部１０ｆの内側には、図１に示すように、振動板１の対向する２辺を支持するための支持部１０ｇが、段差部１０ｆより一段低く形成されている。そのため、支持部１０ｇ上に振動板１を載置すると、振動板１の天面と端子１１，１２の内側部１１ａ，１２ａの上面とがほぼ同一高さになる。なお、底壁部１０ａには第１の放音孔１０ｈが形成されている。

【００１５】端子１１，１２のインサート成形時には、図１０（ａ）に示すように外側部１１ｂ，１２ｂがケース１０の両側方へ水平に延びている。その後、図１０（ｂ）のように端子１１，１２の外側部１１ｂ，１２ｂの中間部より先端側を下方へ折り曲げる。このとき、折り曲げ角度を９０度よりやや大きくするのがよい。そして、図１０（ｃ）のように端子１１，１２の外側部１１ｂ，１２ｂの付け根部分で下方へ折り曲げ、端子１１，１２の内側面をケース１０の側面に沿わせる。この状態で、折り曲げた部分がケース１０の底面に形成された溝１０ｉに嵌合されるが、図１０の（ｂ）で９０度以上に折り曲げることで、端子１１，１２の外側部１１ｂ，１２ｂ先端がケース１０の底面から浮き上がるのを防止できる。

【００１６】振動板１はケース１０に収納され、４箇所で弾性支持剤１３によって端子１１，１２の両翼部１１

ｄ，１２ｄに固定される。すなわち、対角位置にある切欠部８ａに露出する主面電極２と端子１１の一方の翼部１１ｄとの間、および切欠部８ｂに露出する補助電極７と端子１２の一方の翼部１２ｄとの間に、弾性支持剤１３が塗布される。また、残りの対角位置にある２箇所についても弾性支持剤１３が塗布される。なお、ここでは弾性支持剤１３を横長な楕円形に塗布したが、塗布形状は楕円形に限るものではない。弾性支持剤１３としては、例えば硬化後のヤング率が３．７×１０^{6} Ｐａのウレタン系接着剤が使用される。また、この弾性支持剤１３の未硬化状態での粘性が高く（例えば５０～１２０ｄＰａ・ｓ）、滲みにくい性質を有するので、弾性支持剤１３を塗布したとき、弾性支持剤１３が振動板１とケース１０との隙間を通って支持部１０ｇまで流れ落ちる恐れがない。弾性支持剤１３を塗布した後、加熱硬化させる。なお、振動板１の固定方法としては、振動板１をケース１０に収納した後でディスペンサなどで弾性支持剤１３を塗布してもよいが、振動板１に予め弾性支持剤１３を塗布した状態で振動板１をケース１０に収容してもよい。

【００１７】弾性支持剤１３を硬化させた後、導電性接着剤１４を楕円形に塗布された弾性支持剤１３の上を交差するように楕円形に塗布し、主面電極２と端子１１の翼部１１ｄ、補助電極７と端子１２の翼部１２ｄとをそれぞれ接続する。導電性接着剤１４としては、例えば硬化後のヤング率が０．３×１０^{9} Ｐａのウレタン系導電ペーストが使用される。導電性接着剤１４を塗布した後、これを加熱硬化させる。導電性接着剤１４の塗布形状は楕円形に限るものではなく、弾性支持剤１３を跨いで主面電極２と翼部１１ｄ、補助電極７と翼部１２ｄとを接続できればよい。

【００１８】導電性接着剤１４を塗布，硬化させた後、弾性封止剤１５を振動板１の周囲全周とケース１０の内周部との隙間に塗布し、振動板１の表側と裏側との間の空気漏れを防止する。弾性封止剤１５を環状に塗布した後、加熱硬化させる。弾性封止剤１５としては、例えば硬化後のヤング率が３．０×１０^{5} Ｐａのシリコーン系接着剤が使用される。なお、図４に示すように、２つの側壁部１０ｃ，１０ｅの内側であって支持部１０ｇより低い位置に弾性封止剤１５の流れ止め用溝部１０ｊを形成してもよい。この場合には、溝部１０ｊによって弾性封止剤１５が底壁部１０ａまで流れ落ちるのを防止できる。

【００１９】上記のように振動板１をケース１０に固定した後、ケース１０の上面開口部に蓋板２０が接着剤２１によって接着される。蓋板２０はケース１０と同様な材料で形成される。蓋板２０を接着することで、蓋板２０と振動板１との間に音響空間が形成される。蓋板２０には、第２の放音孔２２が形成されている。上記のようにして表面実装型の圧電型電気音響変換器が完成する。

【００２０】この実施形態の電気音響変換器では、端子１１，１２間に所定の交番電圧を印加することで、振動板１を面積屈曲モードで屈曲振動させることができる。分極方向と電界方向とが同一方向である圧電セラミックス層は平面方向に縮み、分極方向と電界方向とが逆方向である圧電セラミックス層は平面方向に伸びるので、全体として厚み方向に屈曲する。この実施形態では、振動板１がセラミックスの積層構造体であり、厚み方向に順に配置された２つの振動領域（セラミックス層）が相互に逆方向に振動するので、ユニモルフ型振動板に比べて大きな変位量、つまり大きな音圧を得ることができる。

【００２１】この実施形態にかかる電気音響変換器をプリント基板などに表面実装する際、リフロー半田などの熱によりケース１０が熱膨張する。セラミックスよりなる振動板１は樹脂製のケース１０に比べて熱膨張係数が小さいので、振動板１には引張応力が作用する。この引張力のため、振動板１の特性が変化したり、割れが発生する可能性がある。ところが、ケース１０にインサート成形された端子１１，１２の両翼部１１ｄ，１２ｄは、図９に示すようにケース１０の内側へ変位可能であるため、振動板１にかかる引張応力を軽減できる。そのため、振動板１の特性が変化したり、割れが発生するのを防止できる。

【００２２】図１１は本発明にかかる端子の他の例を示す。この実施形態では、端子１１，１２の胴部１１ｃ，１２ｃと両翼部１１ｄ，１２ｄとの間に、応力緩和部であるクランク形状部１１ｈ，１２ｈを設けたものである。この場合には、第１実施形態のような幅狭部１１ｆ，１２ｆに比べて両翼部１１ｄ，１２ｄの変位が一層容易になる。

【００２３】図１２は本発明に係る電気音響変換器の第２実施形態を示す。この実施形態では、端子１１，１２の胴部１１ｃ，１２ｃと両翼部１１ｄ，１２ｄとの間に、応力緩和部であるクランク形状部１１ｈ，１２ｈを設けるとともに、端子１１，１２の両翼部１１ｄ，１２ｄをケース１０に移動不能に固定し、胴部１１ｃ，１２ｃをケース１０の側壁部１０ｂ，１０ｄに対して内外方向に移動可能としたものである。なお、この場合には、胴部１１ｃ，１２ｃに樹脂充填穴１１ｅ，１２ｅを設けない。

【００２４】この場合には、表面実装したプリント基板から半田付け部である端子１１，１２の外側部１１ｂ，１２ｂに加わった応力を、胴部１１ｃ，１２ｃが内外方向に移動することによって緩和する。また、胴部１１ｃ，１２ｃの変位は、胴部１１ｃ，１２ｃと両翼部１１ｄ，１２ｄとの間に設けられた応力緩和部１１ｈ，１２ｈによって吸収できる。なお、応力緩和部１１ｈ，１２ｈとして図１１に記載の構造を採用したが、図７のような幅狭部であってもよい。

【００２５】本発明は上記実施形態に限定されるもので

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はなく、本発明の趣旨を逸脱しない範囲で変更可能である。上記実施形態の圧電振動板は２層の圧電セラミックス層を積層したものであるが、３層以上の圧電セラミックス層を積層したものでもよい。また、圧電振動板として、圧電セラミックス層の積層体に限らず、金属板の片面または両面に圧電板を貼り付けたユニモルフ型またはバイモルフ型振動板を用いてもよい。また、端子１１，１２の胴部１１Ｃ，１２Ｃの両側に翼部１１ｄ，１２ｄを設けるものに限らず、振動板に導通する一方側に翼部１１ｄ，１２ｄを設けてもよい。さらにまた、ケース１０の２辺の支持部の１０ｇにかえて、ケース内側の４角隅部に支持部を設けてもよい。本発明の筐体は、圧電振動板を収納し、端子をインサート成形するものであればよく、実施形態のような凹断面形状のケースと、その上面に接着される蓋板とで構成されたものに限らない。

【００２６】

【発明の効果】以上の説明で明らかなように、請求項１に記載の発明によれば、筐体の内部に導入されたインサート端子の一端部に、胴部とこの胴部から側方に向かって延びる翼部とを設け、胴部を筐体に固定するとともに、翼部を筐体に対して移動可能とする。そして、端子の胴部と翼部との間に応力緩和部を設け、翼部が筐体の内側方向に変位可能としたので、周囲の温度変化などにより圧電振動板に応力が作用した場合でも、その応力を端子の翼部が筐体の内側方向に撓んで吸収する。そのため、圧電振動板の割れは勿論、電気的特性の変化も生じず、安定した特性が得られる。

【図面の簡単な説明】

【図１】本発明に係る圧電型電気音響変換器の第１実施形態の分解斜視図である。

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【図２】図１に示す圧電型電気音響変換器の蓋板および弾性封止剤を除外した状態の平面図である。

【図３】図２のＡ－Ａ線階段断面図である。

【図４】図２のＢ－Ｂ線断面図である。

【図５】図１の圧電型電気音響変換器に用いられる圧電振動板の斜視図である。

【図６】図５のＣ－Ｃ線による階段断面図である。

【図７】端子の斜視図である。

【図８】一方の端子がケースに対して変位する様子を示す斜視図である。

【図９】一方の端子がケースに対して変位する様子を示す平面図である。

【図１０】ケースにインサート成形した端子を折り曲げる工程を示す工程図である。

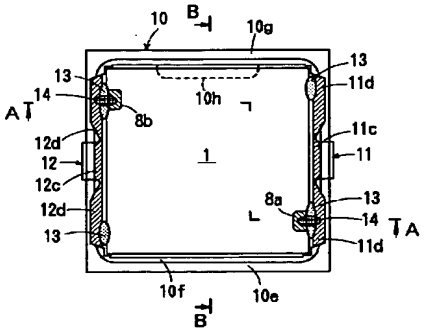
【図１１】端子の他の例の平面図である。

【図１２】本発明に係る圧電型電気音響変換器の第２実施形態の蓋板および弾性封止剤を除外した状態の平面図である。

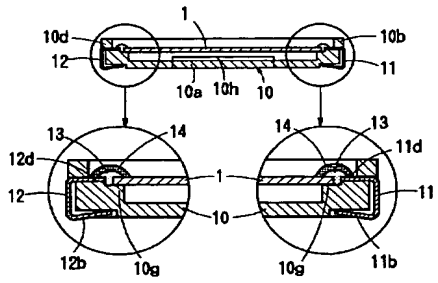
【符号の説明】

１	圧電振動板
１０	ケース
１０ｇ	支持部
１１，１２	端子
１１ａ，１２ａ	内側部（一端部）
１１ｂ，１２ｂ	外側部（他端部）
１１ｃ，１２ｃ	胴部
１１ｄ，１２ｄ	翼部
１４	導電性接着剤
１５	弾性封止剤
２０	蓋板

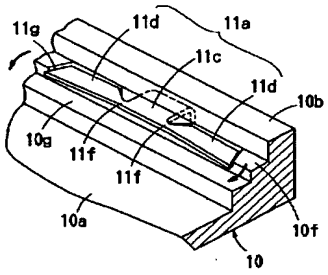
【図２】



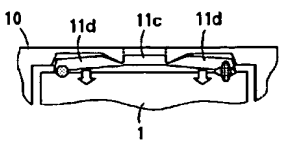
【図３】



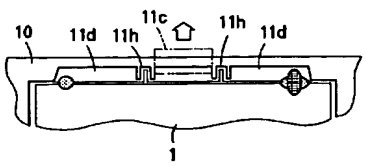
【図８】



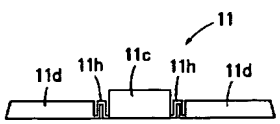
【図９】



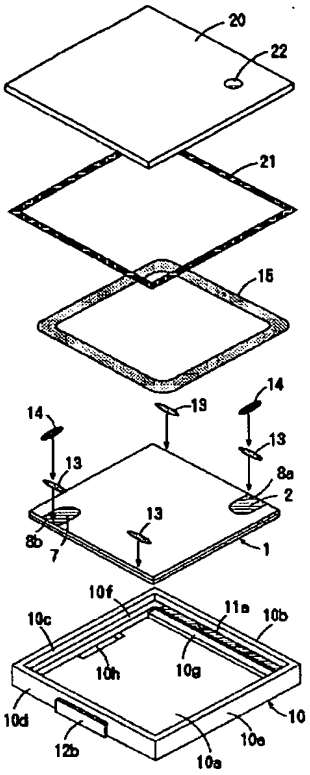
【図１２】



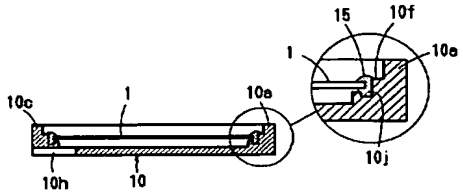
【図１１】



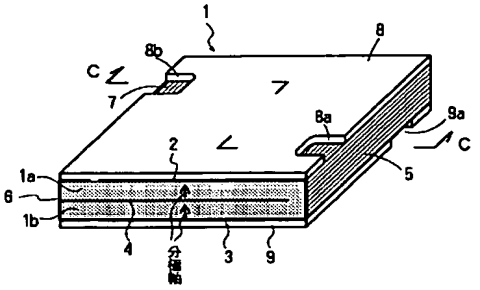
【図１】



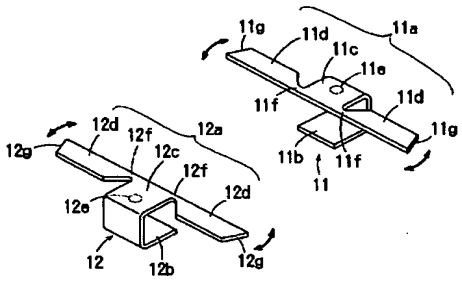
【図４】



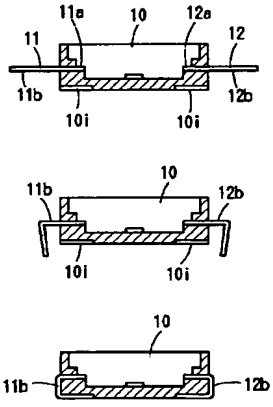
【図５】



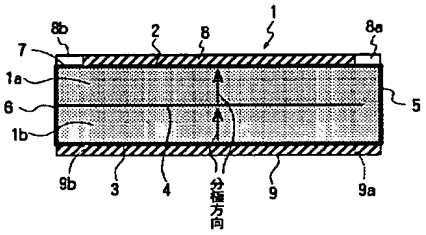
【図７】



【図１０】



【図６】



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